

How To use AI solutions when engineering systems and software

ESA SPA Workshop 2025 – ESTEC
Patricia Rodríguez Dapena

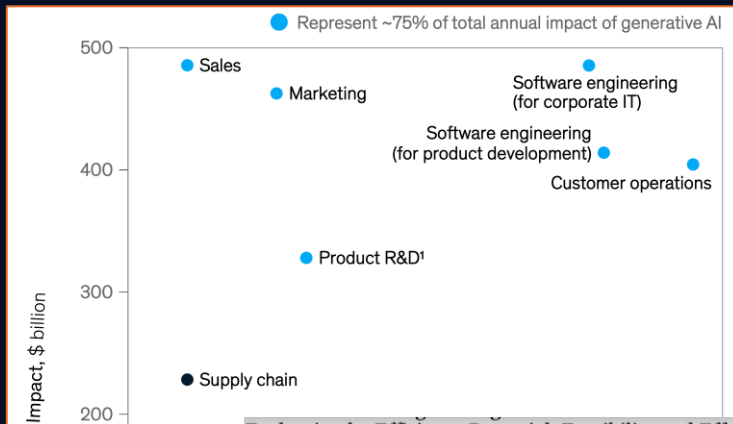
- 1.- How to embrace AI solutions to perform engineering activities (with examples)
- 2.- Effects to the ECSS
- 3.- Conclusions

1.- How to embrace AI solutions to perform engineering activities

Main premises for Business benefits and growth

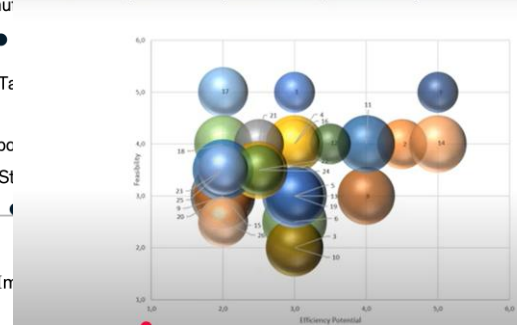
① Using generative AI in just a few functions could drive most of the technology's impact across potential corporate use cases.

② Businesses' AI maturity model: different models similarly defined: From immature to strategic implementation



GenAI has a high impact on product development and can dramatically improve engineering efficiency

Evaluation by Efficiency Potential, Feasibility and Effort



UC#	Use Case Name
1	Market analysis
2	Requirements engineering
3	Specification and model generation
4	Quality analysis
5	Assistants for CAD/CAE
6	Assistants for E/E design
7	Assistants for SW development
8	CR analysis
9	Production planning
10	Lifecycle management
11	Field analysis / DOE
12	Homologation
13	Analysis support
14	Test case & plan generation
15	Test data generation
16	Automated Compliance Checking
17	User & repair manual generation
18	Cost estimation
19	Supplier selection
20	Configuration management
21	Risk management
22	Project management
23	Product & Portfolio management
24	Patent management
25	Innovation management
26	State-of-the-art monitoring
27	Variant Management

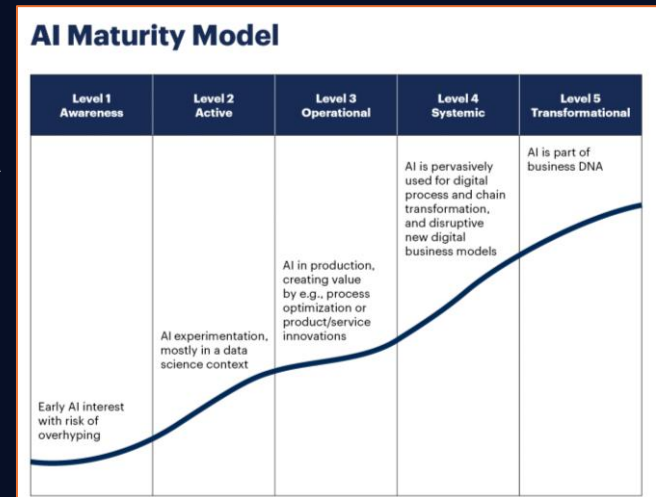
Note: Impact is averaged.

¹Excluding software engineering.

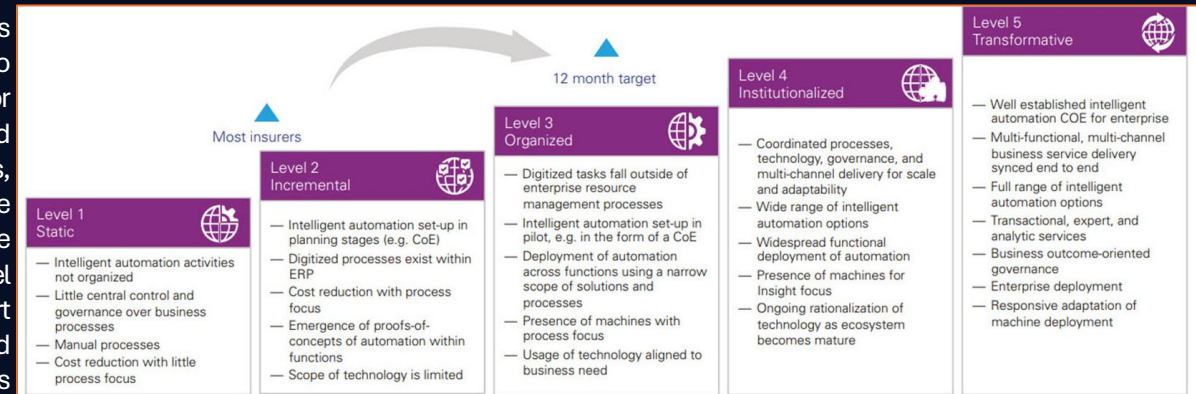
Source: Comparative Industry Service (CIS), IHS Markit; Oxford Economics; McKinsey Corporate and Business Functions database; McKinsey Manufacturing and Supply Chain 360; McKinsey Sales Navigator; Ignite, a McKinsey database; McKinsey analysis. **McKinsey & Company**

Ref: McKinsey&Company: The economic potential of generative AI. The next productivity frontier. June 2023

Gartner® organizes businesses' IA maturity into five levels, from static or "one-off" limited implementations or trials, through to transformative implementation at the organizational level designed to support business goals and objectives.



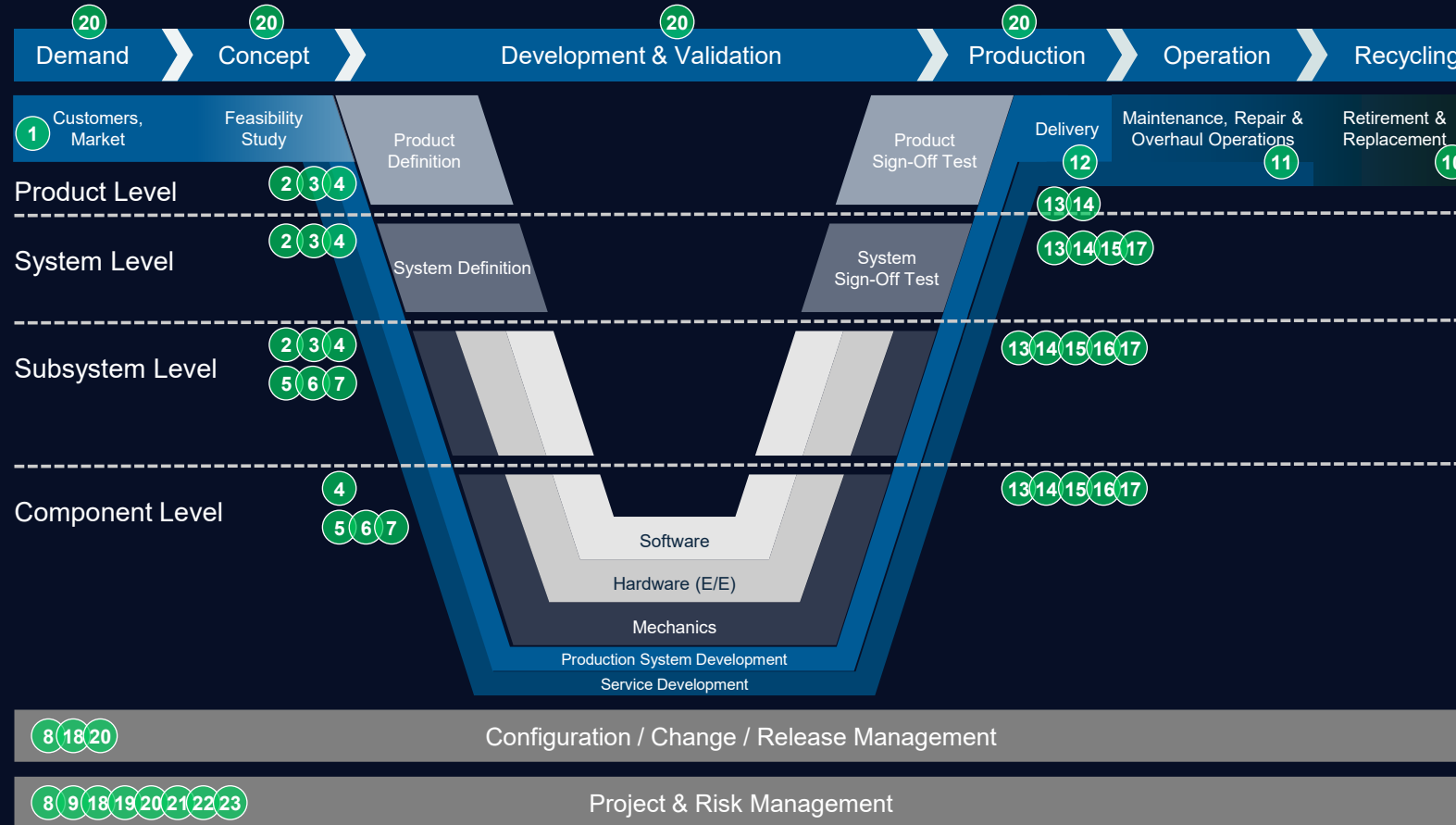
KPMG® organizes businesses' IA maturity into five levels, from static or "one-off" limited implementations or trials, through to transformative implementation at the organizational level designed to support business goals and objectives



1.- How to embrace AI solutions to perform engineering activities

GenAI use cases in Engineering

- 1: Market analysis
- 2: Requirements analysis
- 3: Specification and model generation
- 4: Quality analysis
- 5: Assistants for CAD/CAE
- 6: Assistants for mechanical design
- 7: Assistants for SW development
- 8: CR analysis
- 9: Production planning
- 10: Lifecycle management
- 11: Field analysis
- 12: Homologation



- 13: Analysis support
- 14: Test generation
- 15: Test data generation
- 16: SiL test automation
- 17: Test optimization and simulation
- 18: Cost estimation
- 19: Supplier selection
- 20: Process automation
- 21: Risk management
- 22: Project planning
- 23: Knowledge management

1.- How to embrace AI solutions to perform engineering activities

With an organized AI embracement approach, organizations change from incipient trial stages like the 1st or 2nd ones below to the 3rd one:

1st.- AI Use Cases with **isolated** methods and tools by individuals; with not clear measurable improvement of employee efficiency

2nd.- Workflows with **Automated** task flow, pre-orchestrated by code; and now Improving methods and individual processes

3rd.- Agentic Product/System Development Process, now with **Autonomous execution of tasks and tools** without pre-defined sequence or iterations; now Improving overall Product/System Development Processes.



1.- How to embrace AI solutions to perform engineering activities

Stages and challenges for embracing GenAI

Organizations at this stage are beginning to recognize the potential of AI. Interest is sparked, but practical experience with AI is limited.

Challenges:

- Overcoming initial skepticism and building a basic understanding of AI capabilities and limitations.
- Where to start and how to align AI with existing business processes..



Defining the strategic Vision
Assess Current Capabilities

1. Initial
Exploration

2. Experimentation
and Pilot Projects

Companies start small-scale AI experiments, typically in the form of pilot projects. This stage is about testing it, learning from practical experience, and understanding the implications of AI for the business.

Challenges:

- selecting the right pilot projects that can provide meaningful insights without overwhelming resources
- managing expectations, as early experiments may not yield immediate or significant results.



Selecting and Managing Pilot Projects.
Developing Internal AI Expertise.

5. Transformation
and Innovation

3. Operational
Integration

Successful pilot projects lead to the integration of AI into operational processes. AI begins to play a more significant role, enhancing efficiency, and contributing to decision-making.

Challenges:

- Integrating AI into existing systems and workflows can be complex, requiring not just technical adjustments but also cultural shifts within the organization.
- Ensuring that employees are on board and adequately trained to work alongside AI systems is crucial
- E.g. new AI organizational responsables, special IT technology



Integrating AI into Business Processes.
Scaling AI Initiatives.

4. Strategic
Adoption

AI is no longer seen as just a tool but strategically. It is deeply embedded in the company's strategy, driving business decisions, innovation, and competitive advantage.

Challenges:

- Maintaining momentum in AI adoption, continuously innovating.
- Ensuring that AI initiatives remain aligned with the evolving business strategy and market conditions is critical.



Aligning AI with Business Strategy.
Invest in AI training for employees.

Driving Business Transformation with
AI. Ethical AI Deployment, and
Governance



1.- How to embrace AI solutions to perform engineering activities

Stages and challenges for embracing GenAI

Talent & Culture

Extend and personalize training

Role **Evolution**

People first. Change Management

Value Development

Customer Value Creation. From GenAI to Agentic

Engagement Models

Productive Model

Toolset Agentic evolution

From tool adoption to real P&L impact

Internal Processes

From Human Centric to Agentic driven

Organization scalability

1.- How to embrace AI solutions to perform engineering activities

Case example



Generative AI to boost productivity at NTT Data

Business need

In line with our strategy of early and wide adoption of cutting-edge trends, we are focused on hyper-automation, Generative AI, Agentic AI...

Our mission is clear: OnePlatform, OneStrategy, OneCompany.

NTT Data develops SW applications for multiple sectors, including maintenance services. In addition, and as an example of activities related to engineering, we perform ISVV projects for ESA's space programmes, so faces challenges with:

- Time-intensive, manual activities when datapackages arrive to be performed in short er and shorter time.
- A need to streamline processes to increase speed, accuracy, and efficiency.

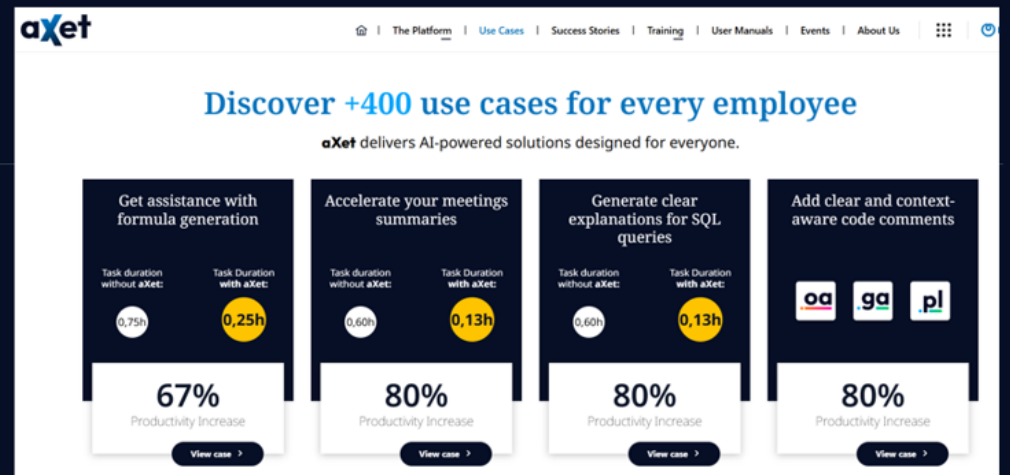
Outcomes

- ✓ Increased efficiency and productivity, allowing teams to focus on higher-value tasks. Reduced effort by:

Solution

The AI Inside Transformation COE team leads this transformation, equipping our global teams with the tools, knowledge, and vision to integrate AI into our daily operations and future goals.

NTT DATA Developed the AXET framework that helps ALL employees no matter their role and responsibilities:



1.- How to embrace AI solutions to perform engineering activities

Case example



Case study | Continental | Germany | Automotive

Generative AI to boost productivity at Continental

Business need

Continental's R&D division, particularly within the Automotive **User Experience (UX)** business unit, faces challenges with:

- Time-intensive, manual extraction of regulatory and client requirements and Manual classification of requirements across various dimensions, leading to inconsistencies.
- A need to streamline processes to increase speed, accuracy, and efficiency.

Solution

NTT DATA Developed the **AI Shadow**, which automates critical R&D processes at Continental using Microsoft Azure's AI capabilities. The solution addresses:

- Automated Requirements Extraction: Reducing manual input by extracting atomic requirements from documents.
- Requirements Classification: Multi-dimensional categorization of requirements to ensure accuracy and compliance, e.g. regarding safety relevance.
- Automated Feature Mapping: Faster and more accurate mapping of requirements to product features incl. generation of feature plans.

Outcomes

The AI Shadow Value Discovery PoC has produced the following results:

- ✓ Increased efficiency and productivity, allowing teams to focus on higher-value tasks. Reduced effort by 50%.

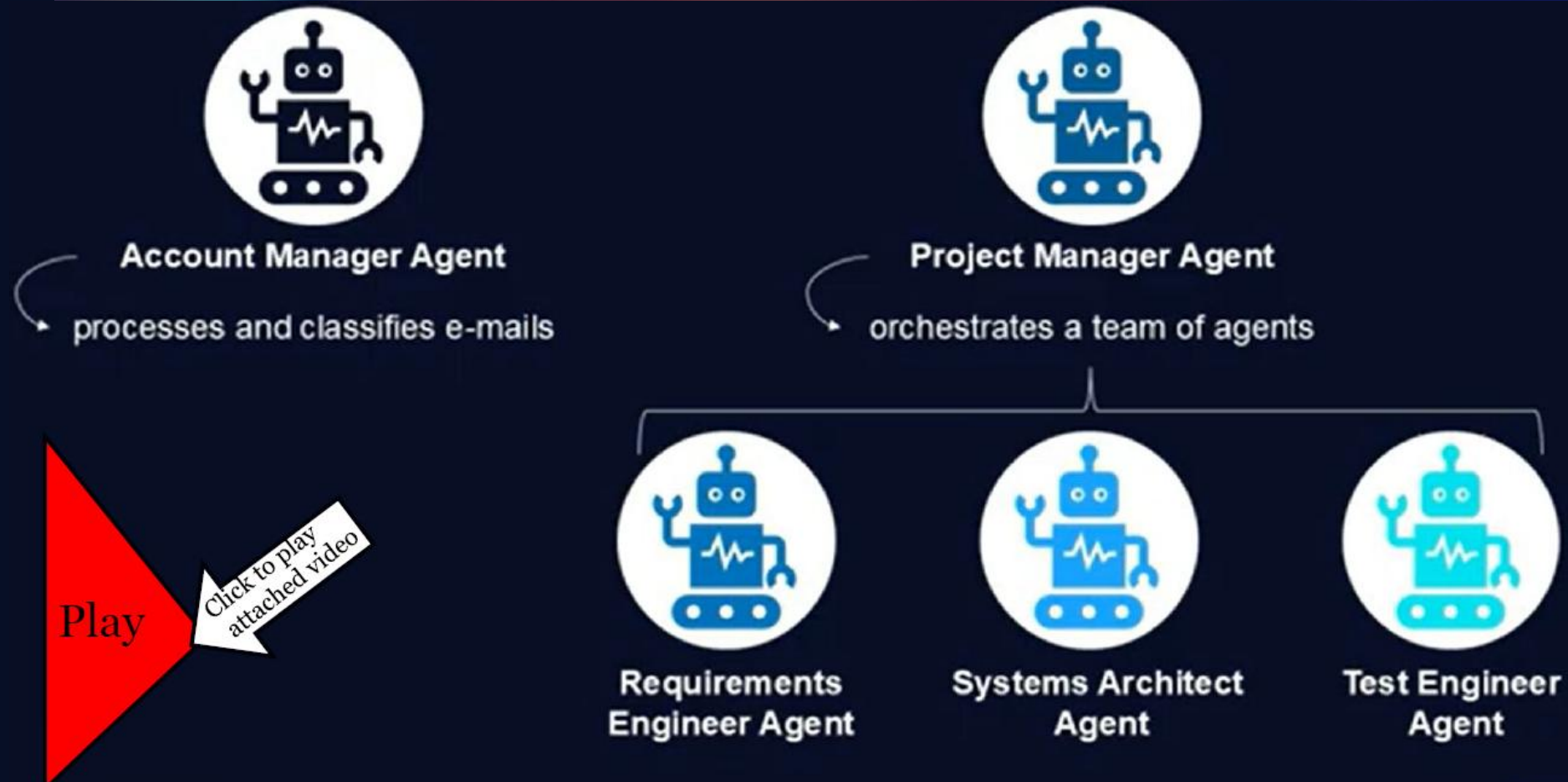
- ✓ Estimated savings bigger than 1M€ in operational savings.
- ✓ Shift engineers from reading documents back to engineering tasks and increase development efficiency.
- ✓ Enhanced compliance with regulatory and safety standards, improving product quality.

“ There is nothing more to add, as it has already been stated multiple times – the results, and especially the collaboration with you and your team, were outstanding! Continental is impressed by NTT DATA's ability to translate our complex needs into practical, scalable solutions.

Michael Sicker, Director R&D Transformation, Continental

1.- How to embrace AI solutions to perform engineering activities

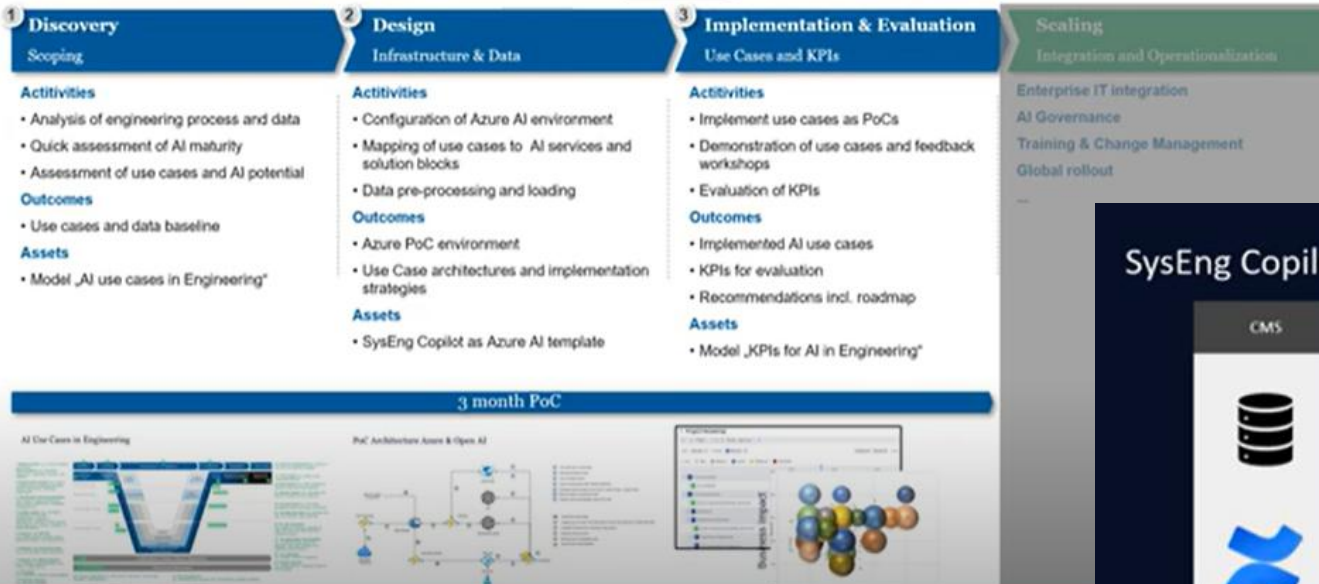
Case example



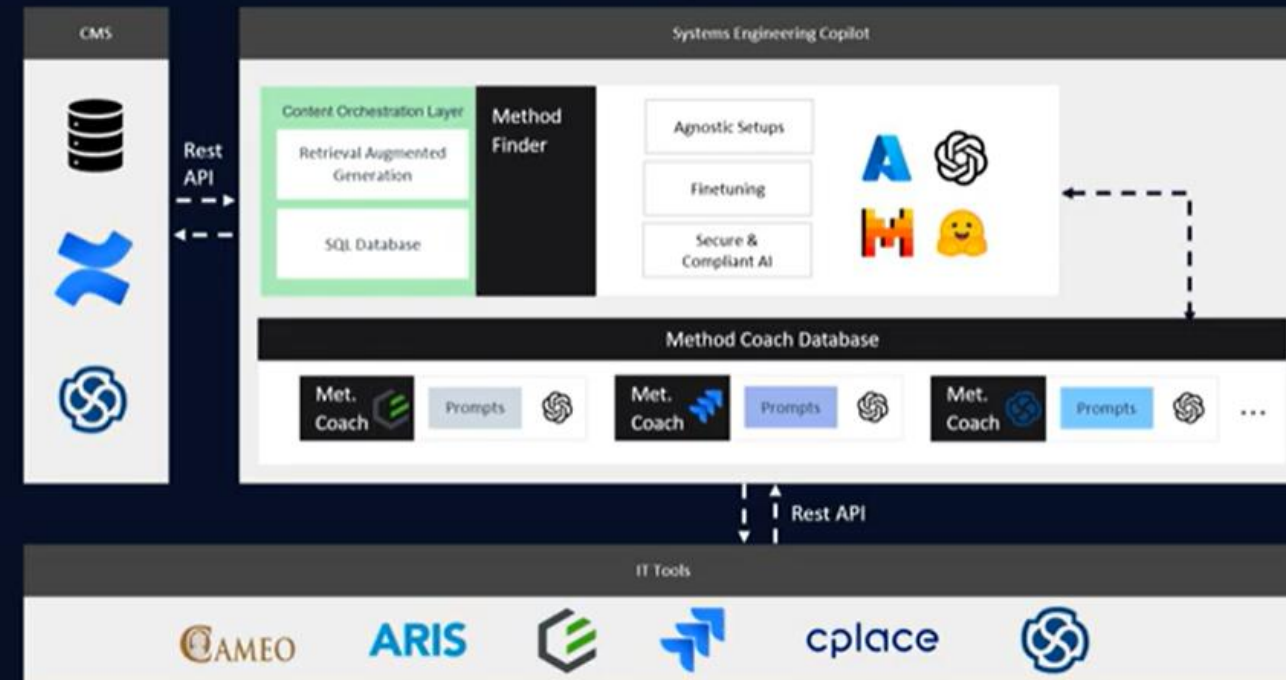
1.- How to embrace AI solutions to perform engineering activities

Case example

Value Discovery PoC: AI in Engineering



SysEng Copilot's modular architecture enables progressive scalability



2.- Effects to ECSS

Using GenAI support, we:

- » **Benefit** by, for example, increasing productivity, efficiency, focus and happiness? of the team, by increasing the quality of the result, faster time to market and increase the innovations and market growth of companies.
- » **Need** an initial ramp-up learning curve for its incremental and careful adoption, cultural changes are not always popular nor fast, each organization needs its own way,

We are sure ALL of you will adopt it very soon. Let's not miss the wave!

In European projects we need to comply with project tailored ECSS standards. But when using GenAI, we need to comply with **other added** international regulations related to GenAI (e.g. EU AI Act: first regulation on artificial intelligence¹; Data privacy/security regulations²; etc). More regulations about the use of GenAI are coming.

Only focusing on ECSS in projects:

- How are ECSS standards requirements implementation affected?
- How are the different engineering activities to be performed now by engineers?
- What is the quality level of the resulting work products?
- Do we need tool qualification and how much can we do?

¹ <https://www.europarl.europa.eu/topics/en/article/20230601STO93804/eu-ai-act-first-regulation-on-artificial-intelligence>

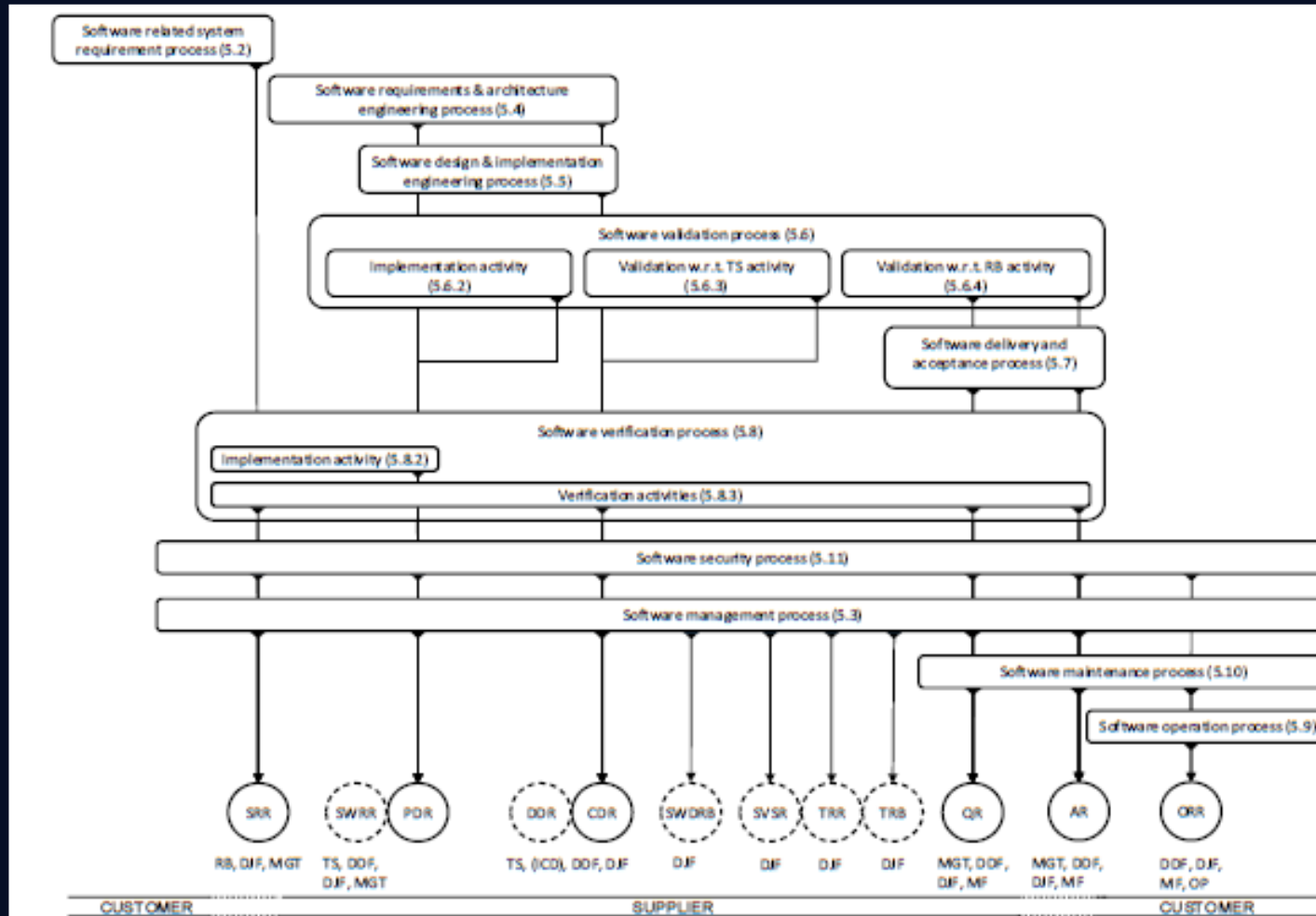
² Generative AI and the EUDPR. First EDPS (European Data Protection Supervisor) Orientations for ensuring data protection compliance when using Generative AI systems 03 June 2024
[24-06-03_genai_orientations_en.pdf](#)

2.- Effects to ECSS

How are ECSS standards requirements implementation affected - today?

Depending on the level of use of GenAI, ECSS manual activities/requirements can vary from being just supported to be 100% automatized.

e.g. ECSS-E-ST-40 rev1



2.- Effects to ECSS

How are ECSS standards requirements implementation affected - today?

For the requirements definition and analysis process, we can:

- > automate requirements definition
- > automate requirements completeness, consistency verification
- > a thorough technical MANUAL review will be needed for ensuring appropriateness and feasibility

For the architectural definition process, we can:

- > automate some diagram and block/components definition -> **today not proper AD can be defined YET! without an 'intelligent agent'**
- > an agent can be developed to create the AD using SYSML v2 (the textual outputs of SYSML v2 can help in automatize/parametrize variability when product lines are concerned)
- > a thorough technical MANUAL review will be needed for ensuring appropriateness and feasibility

For the detailed design definition process, we can:

- > today not proper DD can be defined YET! without an 'intelligent agent'
- > Reverse engineering is always possible from code

For the coding and unit verification, we can:

- > Automatic code generation
- > Verify completeness and consistency
- > automatic UT test case generation, test scripts generation and UT execution
- > automatic code static analysis
- > automatic identification and creation of SPRs

For the code integration and IT, we can:

- > automatic IT test case generation, test scripts generation and IT execution
- > automatic identification and creation of SPRs

For the validation, we can:

- > automatic validation test case generation, test scripts generation and execution
- > automatic identification and creation of SPRs

Etc

STILL....

When performing SPA process, we can:

- > automate some quality checks -> **but still need reviews and checks to ensure the engineering activities**
- > For safety and dependability analyses only some support is possible
 - > an agent may be created for SFMECA, SFTA analyses -> but still **need MANUAL inputs, reviews and checks**
- > For processes checks no support is yet provided

BUT....

The following aspects will be a MUST:

- ➔ Solutions to be developed ad-hoc – need some time and effort
- ➔ Tool qualification -> waiving some ECSS requirements
- ➔ Organizational aspects:
 - Shift of paradigm: AI/ML/GenAI embracement, agents and infrastructure development and maintenance
 - Engineers training and IT support group expertise and skills

3.- Conclusions

- AI/ML and GenAI are here to stay: it is now 'needed' and used by everyone – even kids. Often said as 'it is here to stay as when Internet appeared it stayed'
- AI/ML and GenAI can be used for space SW Engineering
- QA level of resulting SW is not jeopardised
- Paradigm change at organizational level - Organizations shall not loose current wave.
- Important benefits are real and measurable
- Embracement is to be performed incrementally – although not for free
- Many ECSS requirement stay
- Different story is when incorporating ML in the operational SW.

Thank you!

Better, Faster, Smarter 5.0
By making engineers' life easier